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ABSTRACT

Classroom teachers have long used group activities as part of their repertoire of teaching techniques. Personalities, goals, the group dynamic, the teacher's level of supervision, and other factors play a role in the efficacy of student collaboration. This paper describes five cooperative learning techniques: student teams-achievement divisions; teams-games-tournament; jigsaw; group investigation; and learning together. It then discusses student team learning, cooperative learning outcomes, and computer-mediated cooperative learning. Ten associated figures (included in Appendix C of IR 017 960) are then described. (Contains 14 references.) (AEF)

## Title:

# Cooperative Software for the Internet

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Classroom teachers have long used group activities as part of their repertoire of teaching techniques. Having students work together in groups sometimes produces meaningful results and sometimes doesn't. Personalities, goals, the group dynamic, the teacher's level of supervision, and myriad other factors all play a role in the efficacy of the collaboration. One specific kind of group activity which has a history of success is cooperative learning. Although social psychological research on cooperation can be traced back to the 1920s (Slavin, 1977), classroom research did not begin in earnest until the 1970s. At that time, four groups of researchers working independently started to develop and research cooperative learning methods for the classroom (Slavin, 1990). Slavin's team at Johns Hopkins University developed "Student Teams–Achievement Divisions" (STAD) (Slavin, 1978) and "Teams–Games–Tournaments" (TGT) (DeVries and Slavin, 1978); Aronson , Blaney, Stephan, Sikes, and Snapp (1978) designed the "Jigsaw" technique; Sharan and Sharan (1976) produced the "Group Investigation" method at the University of Tel-Aviv; and Johnson and Johnson (1975) working at the University of Minnesota devised the "Learning Together" model for cooperative learning. Although the precise details and the full research results of these pioneering efforts are beyond the scope of this paper, it is instructive for the purposes of this paper to examine the basic premise of each.

## Cooperative Learning Techniques

### *Student Teams–Achievement Divisions*

In STAD, each group comprises four members, selected toward achieving a mixture of performance levels, gender, and ethnicity. The teacher presents the lesson in a conventional manner, after which the students work within their groups—now called "teams"—to ensure that all team members have mastered the lesson. Within the team, the students can use a variety of techniques to help each other learn the material. After a suitable period of time, the students then take a quiz individually. A student's quiz score is then compared to his or her own past average, and points are awarded for meeting or exceeding that average. These points are then pooled for the entire team to arrive at a team score. Teams that attain a pre-specified level receive certificates or other rewards (Slavin, 1986).

### *Teams–Games–Tournaments*

Like STAD, TGT has the same teacher presentation of the lesson and the same group composition. Instead of quizzes, however, a TGT-based lesson concludes with a tournament in which students compete with members of other teams to earn points for their own teams. A round of the tournament pits students against other students with similar past achievement records. In this manner, low achievers are competing against other low achievers, for example. As a student's cumulative achievement record changes, he or she is "bumped" to a different level. As during the quizzes in STAD, team members are own their own during the actual tournament. The winner of the round contributes points to his or her team's overall score. Also as with STAD, high-scoring teams earn rewards (Slavin, 1986).

### *Jigsaw*

In the originally Jigsaw technique, students are assigned to six-member teams to work on academic material which has been divided into six different sections. Each team member then studies his or her assigned section. Next, all the students who have studied the same section (one student from each group) meet to form an "expert group" to discuss what they have learned. The students then return to their original teams and take turns teaching each other the various sections (Aronson, et al., 1978).

### *Group Investigation*

Unlike the previous methods, the groups in Group Investigation are not necessarily assigned by the teacher. Like Jigsaw, Group Investigation is a task specialization method. The teacher begins by assigning a broad topic for inquiry. The students then break the topic down into subtopics based on their prior knowledge, backgrounds, and interests. Teams, ranging in size from two to six students, are formed by those sharing a common interest. The students then investigate the topic for their groups and prepare a final report to present to the entire class. Traditionally, evaluation for Group Investigation focuses on higher-level thinking skills, with the teacher constantly monitoring each student's academic activity (Sharan & Sharan, 1976).

### *Learning Together*

As in STAD and TGT, Learning Together is based on four-to-five-member groups assigned by the teacher. The members of each group then work together to achieve a common goal, usually the completion of an assignment sheet handed out by the teacher. Individual students are required to demonstrate that they have individually mastered the material. Additionally, Learning Together emphasizes interpersonal and small-group skills by having the students discuss how well their groups are working together to achieve the goal. The developers of Learning Together recommended team grades rather than rewards or certificates (Johnson & Johnson, 1975).

## Student Team Learning

Since the 1970s, these same researchers and others have continued to refine the older cooperative learning techniques and develop new ones. According to Slavin (1990), more than half of all studies of practical cooperative learning techniques, including those cited above, involve what Slavin called "Student Team Learning" methods. The overarching philosophy behind Student Team Learning is that "the students' tasks are not to *do* something as a team but to *learn* something as a team" (Slavin, 1990). This result can be achieved only if all of the team members learn the objectives being taught. Regardless of the name or the specific details, there are three concepts central to all Student Team Learning methods: team rewards, individual accountability, and equal opportunities for success.

Team rewards may consist of certificates, other forms of recognition, or grades. Teams do not compete for limited rewards. If a team reaches a certain criterion, it receives the reward. Teams with equivalent results receive the same reward. Individual accountability ensures that the team's success depends on each of the individual team members. Knowing this, the team focuses its activity on helping and tutoring one another to learn the material. Equal opportunities for success is accomplished through the manner in which rewards are given for a student's having improved upon his or her past performance. Because high-, average-, and low-achievers are equally challenged to do their best, the contribution of each team member is of equal value.

## Cooperative Learning Outcomes

After an analysis of over 70 research studies of cooperative learning, Slavin (1989) concluded that cooperative learning is an effective alternative to traditional teaching methods. Of 63 studies in which academic achievement was measured, 57% found significantly greater achievement than control groups, while 41% found no statistical differences, and only one study found the control group outscoring the cooperative learning group. When Slavin limited the studies to those in which Student Team Learning principles were followed, he further concluded that 34 out of 41 such studies (83%) found significantly positive achievement results.

An underlying aspect of cooperative learning is a building-social-skills component. By designing appropriate activities, the cooperative learning teacher can teach social skills to the students at the same time that content is being taught (Lyman, Foyle, & Azwell, 1993). Haring-Smith (1993) pointed out that real-world jobs require workers to cooperate. She went on to assert that cooperative learning teaches students how to work together in a group, instead of competing against each other. Further, cooperative learning students develop "considerable commitment and caring for each other," according to Johnson and Johnson (1991).

Additionally, Slavin (1990) asserted that cooperative learning improves intergroup relations, encourages acceptance of mainstreamed academically-handicapped students, builds self-esteem, and improves time on task.

## Computer-Mediated Cooperative Learning

Traditionally, cooperative learning assumes that the group's members are working together in the same location and at the same time under the watchful eye of the instructor. The system proposed here—Computer-Mediated Cooperative Learning (CMCL)—allows the students and teacher to be remote from one another in both space and time. As proposed here, CMCL draws on the dictates of cooperative learning, while using computers to provide a true cooperative learning experience. As described below, CMCL assumes that the computers will be networked with e-mail capabilities and access to the Internet. There are two components or modules to CMCL, one for the teacher and another for the student. The teacher's module provides access to tools that enable the teacher to set up, monitor, and supervise the groups or teams. Similarly the students' module provides tools that enable students to communicate with fellow group members and the teacher, establish group goals, monitor the group's progress, access remote Internet sites, and prepare the group's final product.

Because CMCL may or may not take place within a traditional classroom setting, the number of students per group, as well as the number of groups, may not seem to be as constrained as in traditional cooperative learning. However, for the same reasons that traditional cooperative learning limits the number of students per group to six or fewer, it is suggested that the size of CMCL groups follow the same guidelines. The number of groups may not be as important a consideration, except that a large number of groups working simultaneously may have an impact on the teacher's ability to monitor each group's progress sufficiently.

### *The Teacher's Screen*

As seen in figure 1, the teacher's screen is divided horizontally into three basic areas: actions, options, and information.

FIGURE 1
See Appedix C of the *1996 AECT Proceedings*

As the cooperative learning project proceeds, there are essentially three different activities the teacher must complete: preparing the assignment for the students, monitoring their progress, and communicating with them on an ongoing basis. On occasion, the teacher may also need context-specific help about the various functions of the CMCL system. Hence there are buttons in the action area for each of these activities. Once an action has been selected, there are then several subordinate actions to be chosen from; hence the options area. The entire right-hand side of the screen is devoted to an area for providing information, both textual and graphical, relative to each of the actions and options. Below the information area is a control panel providing additional buttons for processing the information.

In addition to the three areas discussed above, the teacher's screen also has a message alert indicator in the upper left corner and a calendar/clock indicator in the upper right corner. Details and possible functions of these two indicators will be described later.

*Preliminary preparations.* Before the CMCL experience can begin, the teacher must first decide upon overall general goals for the groups (see figure 2). The teacher first composes specific directions in terms of the mechanics of the activity: the length and format of the final product, due date(s), grading procedures, and the like. Additionally, the teacher prepares suggestions for the students to use when they are in the various phases of the activity (planning, scheduling, preparing and revising drafts, examining Internet sites, and publishing the final report). Because the preceding preparatory work may be generic in nature, knowledge of the specific topic may not be needed. Indeed, many of the suggestions could be incorporated into the software package itself.

FIGURE 2
See Appedix C of the *1996 AECT Proceedings*

The next step in the preparation stage is to choose a topic for the group (CMCL permits the teacher to assign a different topic to each group if desired). At this point, the teacher may want to add to some of the directions listed above, making them more topic specific or more student specific. For example, depending on the topic, the teacher may have specific suggestions for dividing the material into subtopics for individual team members. The teacher may want to tell a particular group to be sure to include this area or avoid that area, or he or she may want to provide specific instructions for a particular student based on prior knowledge of that student's interests and capabilities. The teacher may also want to explore the Internet to find appropriate sites for a particular group to access. As seen in figure 2, the options area of the teacher's screen contains buttons to provide the teacher with the tools necessary to compose directions and suggestions for the students. CMCL would then make all of this information available to the students, possibly by downloading it to each student's computer, from a central server, or across the Internet.

*Team building.* After the preparations as described above have been made, the teacher is ready to build the teams. Having entering the students' names (and other student-specific information if desired) and specifying the number of teams, the teacher is presented with the screen shown in figure 3.

The options area now contains a list (scrolling if necessary) of the students, and the information area contains a rectangular box or container for each group (again scrolling if necessary). The teacher drags a name from the list into the appropriate box, at which time the name is removed from the list in the options area. This operation proceeds until all the names have been placed in containers. It is also possible to drag a name from one container to another. When the teacher has built the teams, he or she clicks on the "done" button in the control panel area. Appropriate messages would warn the teacher if any students hadn't been placed in a group, or if the pre-specified group size had been exceeded (in either case, the teacher would have the option of overriding CMCL's concern).

FIGURE 3
See Appedix C of the *1996 AECT Proceedings*

If the appropriate information were available, CMCL may also provide options for displaying individual team members grades and the team's grade average to date. Different colors may be used to indicate whether a particular student is a high-, middle-, or low-achiever. With all this information readily available and easily displayed, the teacher could manipulate the groups' composition to guarantee the heterogeneity dictated by most traditional cooperative learning constructs.

*Message center*. Because communication among team members and between the team and the teacher is so vitally important for cooperative learning, CMCL has a message center built into it. Both the teacher and the students have access to the message center for sending and receiving messages. The teacher's message center (see figure 4) uses the options area to display a list of the teams and their members.

FIGURE 4
See Appedix C of the *1996 AECT Proceedings*

This list is expandable and collapsible so that lists of one or more teams' members is displayed, or only the list of teams is displayed. By clicking on an individual student's name, the teacher is presented with a list of messages received from and sent to that student. Previously-read messages, as well those to which a reply had been sent may be indicated (using symbols or colors). Double-clicking on a particular message line displays the entire message. Similar to the functions of most e-mail systems, the buttons in the control panel at the bottom enable the teacher to compose new messages, reply to received messages, forward messages to other students, print messages, archive or delete messages, and so forth. The teacher also has the option of selecting more than one student or even entire teams from the list for the purpose of sending the same message to more than one student at a time. It is also through the message center that the teacher receives drafts and final reports from the teams.

*Activity reports*. Some cooperative learning methods such as Group Investigation require that the teacher evaluate an individual student's achievement by examining the student's higher-order thinking skills (Sharan & Sharan, 1976). By overseeing the students as they work in their groups, the teacher may observe and evaluate the student's work habits, grasp of the subject, thinking processes, and the like. With students working individually at computers possibly remote from the teacher, such evaluation is decidedly more complicated. It is for this reason that CMCL has an "activity reports" function built in (see figure 5).

FIGURE 5
See Appedix C of the *1996 AECT Proceedings*

As students go about their various activities, CMCL keeps track of what the students are doing on the computer. A built-in monitoring system records which activity the student has selected (from the actions and options available to him or her), the date of the activity, and the length of time spent on that activity. When appropriate, CMCL records additional information such as the uniform resource locator (URL) address for any Internet site accessed, details for any messages sent and received, contents of the student's and team's notebooks (discussed in detail later), and so forth.

When the teacher selects "Activity Reports," he or she is given the same expandable/collapsible list as before with a listing for each team and each student. Clicking on a student's name displays a summary report of that student's activity which can then be expanded further to reveal the individual activities. The teacher can then select an activity from that list and examine any additional details in the report (by clicking on the "Details" button in the control strip). Armed with the content and sequence of a student's activity, the teacher should be better able to evaluate that student's progress at any stage of the cooperative learning assignment. Granted, the "time spent" as recorded in an activity report is not necessarily time on task, but the teacher does at least know that the student did indeed engage in that activity for some length of time. It is hoped that the entire scope of a student's activities will form an accurate picture of what the student has done.

***The Student's Screen***

The layout and general function of the student's screen is similar to that for the teacher (see figure 6). It too is divided horizontally into the same three areas: actions, options, and information.

FIGURE 6
See Appedix C of the *1996 AECT Proceedings*

*Message center*. The student's message center functions in a manner similar to that for the teacher. Messages can be sent to and received from fellow team members and the teacher. Depending on the nature of the assignment, the teacher can also enable messaging between members of different teams as well (since some forms of cooperative learning support intergroup collaboration, while others do not).

*Examine assignment*. With this function, the student is able to examine the preparatory information that the teacher has supplied (see figure 7).

FIGURE 7
See Appedix C of the *1996 AECT Proceedings*

A collapsible/expandable list of subjects appears in the option area. Clicking on any one displays the teacher-prepared material in the information area. It is here that the student has access to the generic instructions, as well as specific instructions directed toward the topic, the team, or the individual student. The control panel contains buttons for processing the information (printing, saving, and the like).

*Plan & schedule*. Perhaps no other area of traditional cooperative learning relies as much on the team members' being together as does the planning and scheduling phase of the project. Relying on an awareness of each other's strengths and weaknesses, team members working in person can negotiate precisely who is going to do what and when. Because the team members in CMCL may or may not know each other, may or may not be able to physically meet as a group, CMCL relies on the messaging system for planning and scheduling. After one student is selected from the group, either by the teacher beforehand or by the group via the message center, the teacher activates the planning and scheduling controls for that student alone (see figure 8).

FIGURE 8
See Appedix C of the *1996 AECT Proceedings*

After selecting "plan" from the options area, the designated student is presented with a list of tasks to be completed by the group. The teacher will have already prepared a list of required tasks, as well as list of optional tasks. After consultation with the other team members (via the message center), the designee may add additional tasks to the list by means of keyboard entry. These three different kinds of tasks (required, optional, and student-generated) may be signified by different colors for ease of identification. The student uses a click-and-drag technique (similar to that that the teacher had previously used to assemble the groups) to place the tasks into the team members' boxes. As before, tasks can be moved from one box to another. It is assumed that this division of labor is accomplished after considerable discussion (via the message center) among the group's members. (An alternative to having a designated student assign the tasks would be to have the teacher fill this role. This functionality would then have to be added to the teacher's module.)

After the tasks have been assigned, the student clicks on the "Done" button in the control strip and the task assignments are recorded by the system and made accessible to the other team members. (If any required tasks had not yet been assigned, CMCL would respond with an appropriate message.) The other team members then have the ability to look at the task assignments, but not alter them (prior to that time, any attempt by the other team members to access the planning windows would be met with an "in progress" message). The original designee retains the ability to alter task assignments (move, add, and remove), with the agreement of the group of course. The list of task assignments is available to the teacher through the activity report for the team.

Scheduling proceeds in a similar manner. When a student selects the scheduling option, his or her list of tasks is displayed in the options area. The information area displays a calendar with the teacher-imposed deadlines. The student then drags each task to a box in the calendar. Attempts to place tasks beyond relevant deadlines is met with appropriate warning messages. As with planning, the student can choose to alter the schedule at a future time. A student's schedule is available to the teacher through that student's activity report.

*Examine sites*. The heart of CMCL is the student's ability to examine sites on the Internet. By clicking on the "Examine Sites" button, the student is given two options: searching the Internet or looking at teacher-suggested sites (see figure 9).

FIGURE 9
See Appedix C of the *1996 AECT Proceedings*

CMCL can provide either a keyword search or a content search, possibly using the search engines and content lists already available on the Internet. The interface for this activity is similar to that used by such popular browsers as Netscape and Mosaic. (Although students cannot easily be prevented from conducting irrelevant searches, the absence of buttons such as "What's Hot" and "Cool Sites" may help.) Clicking on "Suggested Sites" displays the sites that the

teacher had previously entered into the system. Again, the display is similar to the list generated by a search in Netscape or Mosaic. Clicking on any listing opens the URL for that listing.

The "Save Site" button in the control strip allows the student to save the site's URL to the student's personal notebook for future reference. While examining a site, a student can select text or graphics to be placed in the student's personal notebook as well. Clicking on the "Save Item" button copies the selected text or graphic to the notebook, downloading the file if necessary.

*Prepare draft.* After the student has gathered information from the Internet, it is time to prepare a draft of his or her portion of the final project (see figure 10). Both the information gathered and the draft itself are saved in the student's personal "notebook."

The "Site List" button permits the student to easily return to the previously-saved URL's on the Internet at the click of the mouse. The "Saved Items" button functions as a "library" of saved items. As with libraries in many software programs, a CMCL library can be viewed an individual item at a time or as a scrolling list of so-called "thumbnails" (abbreviated versions of text items and miniature representations of graphic items). Clicking on a thumbnail displays the complete item.

The "Draft" button enables the student to assemble the results of his or her efforts into a document. Depending on the sophistication and abilities of the students, as well as the nature of the final product (as determined by the teacher), the draft mode may function like an integrated software package such as Microsoft Works®, as a presentation program such as PowerPoint®, as a page layout program such as PageMaker®, or as a web page creation program such as PageMill®, for example. Ideally, this functionality would be built into the CMCL system, but realistically, it may be more efficient to link to a dedicated program instead. Regardless of which route is taken, the student should have full use of appropriate tools for composing and editing text and graphics.

FIGURE 10
See Appedix C of the *1996 AECT Proceedings*

Upon completion, the student can send the draft to fellow team members and the teacher for comment. Using an annotation system similar to that in Microsoft® products, the draft reviewer can attach collapsible Post-it™-like notes to the draft ,which can then be expanded upon receipt by the student who prepared the draft. As computer systems attain increased speed and memory, such annotation might include digitized audio and video from the reviewer.

*Publish report.* As with the planning phase of the project, the publishing of the final report is prepared by one member of the group, determined in advance during task assignment. As might be expected, this student takes the revised drafts from the team members and assembles them into a coherent whole using the same document preparation package as before. Once again, the draft of the final product is shared with the team members and the teacher for comment, using the same annotation system as before. The culmination of this cooperative learning experience is sharing the final product with the rest of the teams via the network.

***Miscellaneous Features***

The "message alert" indicator in the upper left corner of both the teacher's and student's screens may be configured to function in several ways. For example, it may display the number of unread messages, it may flash to indicate that a message has just been received, or it may turn a certain color to indicate that there is an unread message from the teacher.

The "date and time indicator" may likewise be used to display pertinent information for a student. For example, clicking on it may display the amount of time since the person first logged on for the current session, it may display the total amount of time that the person has spent on the project, or it may turn a progressively more intense color as a deadline approaches.

The "Help" button should be context sensitive. It may be configured to provide so-called "balloon help": as the user drags the cursor around the screen, cartoon-like balloons appear explaining the function and features of the item the cursor is currently over. Help may also be set up to display a list of topics that are applicable to the user's current situation. Clicking on any item in the list provides further details.

***Likely Problems***

The hardware and software requirements for CMCL do not come cheaply. It is expected that each student will have the availability of a fast machine with a large monitor (17≤ minimum) and connections to a local area network, a high-quality printer (preferably color), and the Internet. As with many computer-mediated projects, the technology often takes center stage when problems arise: things aren't connected properly, equipment simply doesn't work, network

connections are lost or disabled entirely, students don't know how to operate certain functions of the computer or the software, and so forth. Consequently, the availability of a technician familiar with both the hardware and software is desired.

In light of recent publicity about the availability of pornography on the Internet (Elmer-DeWitt, 1995; Rimm, 1995), many teachers, parents, and students are concerned—justifiably or not—about this aspect of using the Internet. It is therefore assumed that the teacher will at the very least disable searches using words in a predefined list of objectionable terms. It is further hoped that the teacher will use one of the emerging commercial products for blocking access to objectionable sites.

The right of privacy may be another potential concern for some students. Because the teacher will be able to look at a log of each student's activities (sites visited, e-mail messages sent, and the like), it is important that students (and their parents) be made well aware of this feature at the outset. However, the student must not be made to feel that "Big Brother" is watching. The teacher has a legitimate concern for wanting to see this information: he or she needs such information to accurately judge a student's intellectual growth and academic achievement.

Because students may not have the direct, in-person supervision of the teacher, CMCL may be set up so that students are required to complete their work in a logical sequence. For example, they can't prepare the final project before they have divided the tasks and visited some sites. CMCL can be configured so that certain functions are not available (indicated by dimmed buttons, for example) until certain other functions have been given enough attention (assignment of all the tasks, a pre-specified amount of time spent on a certain activity, or a pre-specified number of sites visited, for example).

Performing a certain activity within CMCL may be more time consuming than conducting that same activity in an actual face-to-face meeting. For example, dividing the task assignments requires a fair amount of negotiation, and sending e-mail messages back and forth can slow down this process considerably. If the students are all in the same classroom, there is no reason why they can't complete some activities in person before entering the information into the system.

## Closing Comments

CMCL requires both teachers and students to rethink how teaching and learning take place. It puts an additional burden on the teacher, particularly in terms of preparation and evaluation. Drawing upon the research on cooperative learning and Student Team Learning in particular, CMCL has the same potential for enhancing the learning experience. In addition to using certificates and the like for team rewards, the teacher may also publish the best final products on the Internet. Because each student is responsible for producing his or her own part of the final document, individual accountability is maintained. Finally, because the teacher can monitor an individual student's improvement and offer guidance when necessary, CMCL provides all students with equal opportunities for success.

Since cooperative learning relies so much on the interpersonal relationships among a group's members, it is reasonable to question whether or not learners seated at their own computers—possibly remote from one another, as well as remote from the teacher—can have the same rich, social experience that a group seated at the same table can have. CMCL, especially through the use of the message center and the activity reports which enable the students and teacher to be in constant contact with one other, develops a new kind of group dynamic, but one which has the potential for an engaging and productive social experience.

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